

Next Generation Communication Network for AMI: Comparison of Various Approaches

Alexander Gherman

ADD Grup

Presentation overview

- Current AMI design features.
- Examples of AMI design:
 - NTA 8130 + Dutch Smart Meter requirements.
 - MUC architecture (Germany).
- Comparison and conclusions

Current AMI design features

- Typical AMI parts:
 - End devices (meters, controllers) for various commodity types (electricity, gas, water, heating, ...),
 - Communication network (including concentrators or other connecting devices),
 - AMI master station (optional?),
 - Back-end systems.

Current AMI design features

- Typical functionality of an end device (meter):
 - Metrology,
 - Communications,
 - Connect/Disconnect,
 - Load Control,
 - Demand Response,
 - Power quality,
 - ...

Current AMI design features

- Integrated vs. partitioned end device (“meter”) implementation?
- Possible partitioning into separate units:
 - Metering part,
 - Customer interface part,
 - Communications part,
 - Switch (connect/disconnect) part,
 - ...

Current AMI design features

- Various communication media/channels:
 - Public telecom services (PSTN, GSM/SMS, GPRS, CDMA, WiFi, WiMAX, etc.),
 - PLC (powerline communications) over low voltage distribution network,
 - PLC (powerline communications) over middle voltage distribution network,
 - Wired (cabled),
 - Wireless.

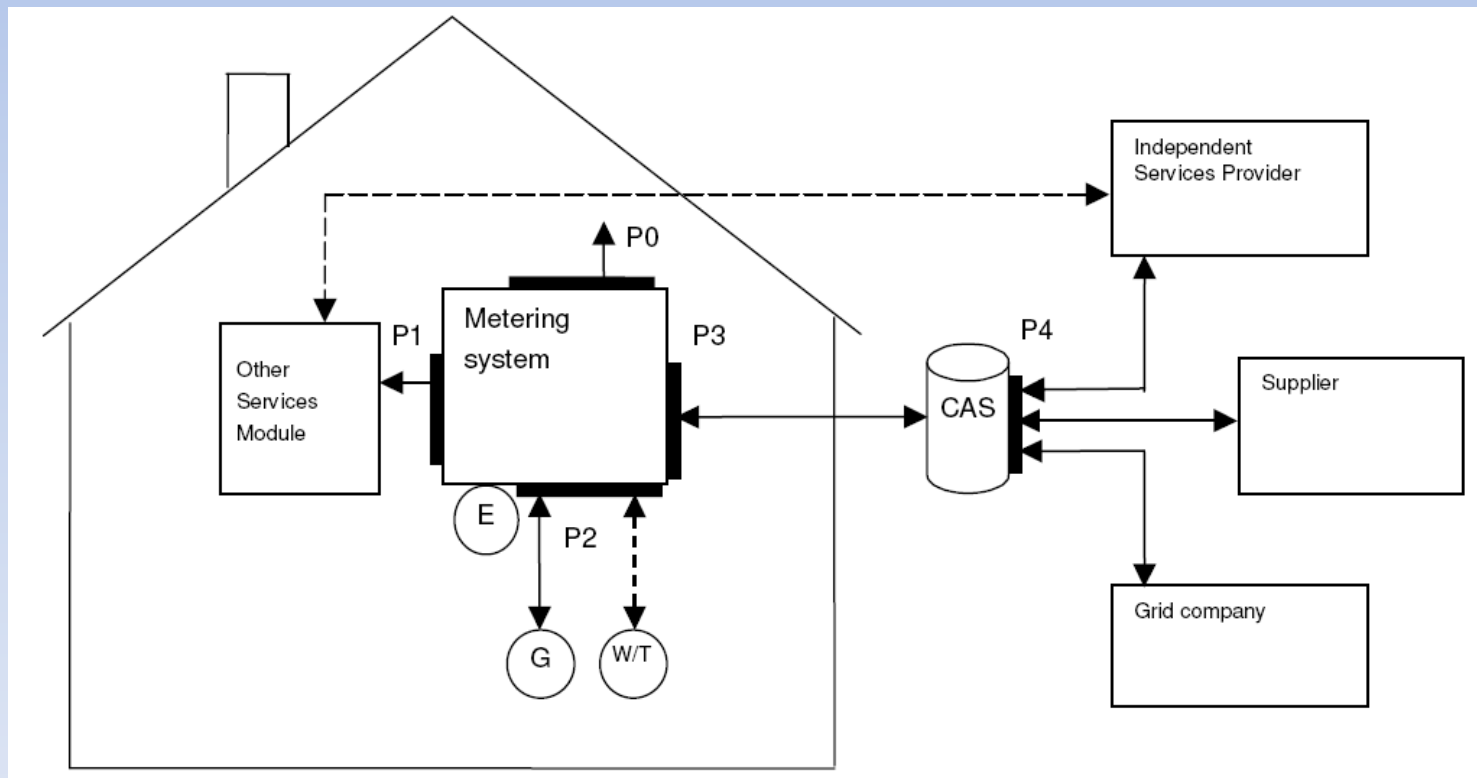
Current AMI design features

- Each medium has its own advantages and disadvantages.
- In general case optimal solution implies a combination of various media.
- Existing standards do not cover all media or are obsolete.
- Generalized (unified) approach to standardization does not exist.

Current AMI design features

- Back-end systems (example):
 - Billing system,
 - Load management,
 - Customer connection/disconnection,
 - Fault investigation,
 - Revenue protection/tamper detection,
 - Quality of supply,
 - ...

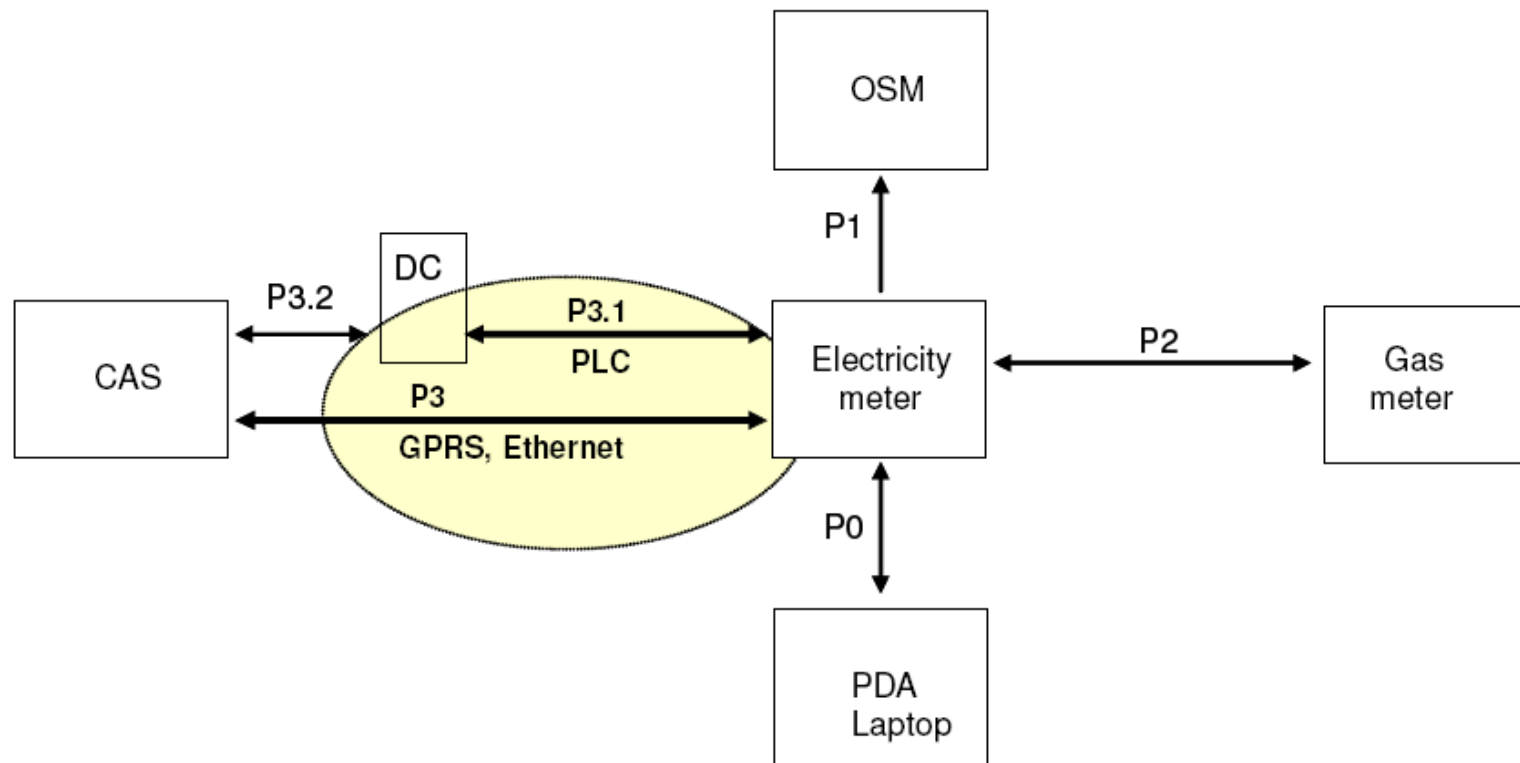
Examples of AMI design: NTA 8130 + Dutch Smart Meter requirements



Examples of AMI design: NTA 8130 + Dutch Smart Meter requirements

- Port P0 for communication with hand-held terminal/laptop during installation and on-site maintenance (IEC 62056-21 mode E, DLMS/COSEM).
- Port P1 for the communication between the metering installation and auxiliary equipment (based on IEC 62056-21 mode D; read-only).
- Port P2 for the communication between the electricity meter and gas/water/heat meters (based on EN 13757-2, EN 13757-4 – wired and wireless M-Bus, respectively, security based on FIPS 197).
Electricity meter gathers, stores data from gas/water/heat meters and forwards it to the CAS (Central Access Server).

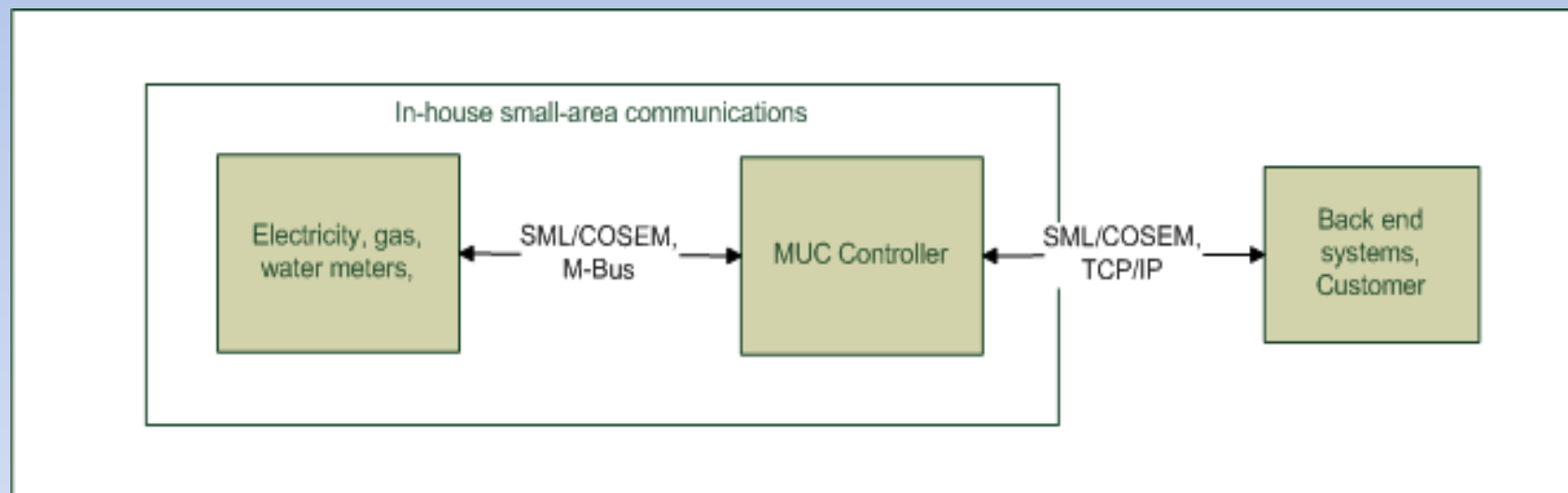
Examples of AMI design: NTA 8130 + Dutch Smart Meter requirements



Examples of AMI design: NTA 8130 + Dutch Smart Meter requirements

- Port P3 for the communication between the metering installation and the CAS. P3.1 interface for PLC is based on IEC 61334-5-1 (S-FSK) and DLMS/COSEM standards. P3.2 interface is not specified yet.
- Port P4 is the port on the CAS with which independent service providers, suppliers and grid companies gain access to the CAS.

Examples of AMI design: MUC architecture (Germany)



Examples of AMI design: MUC architecture (Germany)

- MUC Controller = Multi Utility Communication Controller.
- MUC controller acts as gateway for all types of meters, provides meter data acquisition, storage, forwarding, task scheduling, etc. + communicates with customer.
- Protocols proposed:
 - M-Bus (wired and wireless),
 - SML (Smart Message Language),
 - COSEM,
 - TCP/IP.

Comparison and conclusions

- German (MUC) and Dutch (NTA 8130) solutions use some similar ideas, but in general these two approaches differ dramatically from each other:
 - Different parts, protocols, interfaces.
 - Different device architectures (details see in the next slides).
- Solutions are not interoperable. Distribution companies operating in more than one country will be forced to use different “local” solutions.
- If we imagine a unified European solution, how should such a solution look like?

Comparison and conclusions

- NTA 8130 features:
 - Obviously this architecture is closely related to traditional low-datarate PLC architectures: data concentrator at the transformer substation (network master) communicates with numerous electricity meters installed in the customer premises (slaves) and acts as gateway to CAS (port P3).
 - The next logical step - electricity meter may act as master/gateway for gas/water/heating meters (port P2).
 - Moreover, electricity meter may communicate to other equipment or hand-held unit on behalf of itself or gas/water/heating meters (ports P1 and P0).

Comparison and conclusions

- NTA 8130 features:
 - As a result electricity meter is functionally overloaded: metering itself + customer connecting/disconnecting + data presentation transformation and storage + communications + ... Smart electricity meter becomes too smart...
 - Position of electricity supplier among other commodity suppliers becomes asymmetric: it plays the role of communication provider for water/gas/heating suppliers. Moreover, electricity supplier is responsible for water/gas/heating data security. Is it reasonable? This makes some sense in case of PLC, but is not reasonable in case of other communication media. Electricity supplier becomes too smart...

Comparison and conclusions

- MUC features:
 - MUC approach is free from traditional PLC architecture limitations. It is much more universal and well-shaped.
 - Home metering installation contains MUC controller which acts as dedicated communication gateway (master, hub, router, concentrator, ...).
 - Meters of various types communicate with MUC controller in a similar way using some simple small area communication protocols.
 - Meters can be much more simple in this architecture.
 - It is supposed that MUC controller can easily communicate with back-end systems via internet. Uplink protocol is based on TCP/IP.

Comparison and conclusions

- MUC features:
 - Currently nothing is said about using PLC in the MUC architecture. If a PLC-based solution is used in this architecture, it should allow transporting IP datagrams. One of three low level communication profiles based on S-FSK modulation technique is capable to transport TCP/IP.
 - But S-FSK solutions is too slow (maximum 1200 baud datarate specified in the IEC 61334-5-1 standard). Modern OFDM-based PLC solutions much better meet the requirements, because they are much faster (tens of kbps).
 - Data concentrator at the transformer substation is redundant. More simple IP router is enough.

Comparison and conclusions

- Final conclusion:
 - MUC architecture seems to be more general and harmonious.
 - It can serve as a prototype for a hypothetical unified all-European architecture.
 - Open standards for OFDM-based PLC technology should be elaborated. It must be capable to transport TCP/IP.

Thank you for attention

Alexander Gherman

Alexander.Gherman@addgrup.com